CHAPTER 11

PROCESS PIPING

11-1. GENERAL. The requirements in this chapter pertain to the design of and preparation of plans and specifications for process and/or special purpose piping for which USAEDH has design responsibility. This piping is used in chemical, high pressure air and steam, cryogenics, fuels, process water, and associated systems. Piping/ tubing material is determined by the medium and may range from plastic to stainless steel to special materials. Instrumentation and controls for such systems will provide alarms, interlocks, fail safe hardware, and safe startup and shutdown design features and hardware. Because of corrosion effects, adequate corrosion prevention and decontamination control must be considered for special systems.

11-2. PURPOSE. Requirements and specifications are provided in this chapter to ensure that process and/or special purpose piping systems/equipment conform to fit, form and function, and project design requirements. The system must be operable, maintainable, and contain adequate controls and safety features.

11-3. REFERENCE DOCUMENTS

a. MIL-STD-101, Color Code for Pipelines and for Compressed Gas Cylinders

b. American Society for Testing and Materials Standards

c. American National Standards Institute Standards

(1) B31.1, Power Piping

(2) B31.2, Fuel Gas Piping

(3) B31.3, Petroleum Refinery Piping

(4) B31.5, Refrigerant Piping System

(5) B31.6, Chemical Process Piping

(6) B31.8, Gas Transmission and Distribution Piping Systems

d. American Society of Mechanical Engineers (ASME) Publications. Boiler and Pressure Vessel Code, and Interpretation:

(1) Section I: Power Boilers

(2) Section II: Material Specifications

(3) Section IV: Heating Boilers

(4) Section V: Nondestructive Examination

(5) Section VIII: Pressure Vessels

(6) Section IX: Welding and Brazing Qualifications

(7) Section X: Fiberglass-Reinforced Pressure Vessel

e. Technical Manuals

(1) TM 5-805-4, Noise Control for Mechanical Equipment

(2) TM 5-809-9, Power Plant Acoustics

(3) TM 5-809-10, Seismic Design for Buildings

(4) TM 5-858-1, Gas Distribution

(5) TM 5-848-2, Storage, Distribution, and Dispensing of Aircraft and Automative Fuel

f. AMCR 385-100, Safety Manual

g. Manufacturers Standardization Society (MSS)

(1) SP-58, Pipe Hangers and Supports - Materials, Design and Manufacture

(2) SP-69, Pipe Hangers and Supports - Selection and Application

h. ISA-S5.1, Instrumentation Society of America

i. CE Guide Specification 13080, Seismic Protection for Mechanical, Electrical Equipment

11-4. SUBMITTALS

a. Concept. The concept submittal will include the design analysis with calculations and a narrative to fully explain the design philosophy and criteria used. At this submittal, process flow drawings (PFD) and piping and instrumentation diagrams (P&ID) should be provided. Piping plan drawings should depict the routing of major lines.

b. Intermediate. At the intermediate submittal PFD's and P&ID's should be complete. PFD's should have the flow rates for all process lines identified for the design conditions. P&ID's should have all lines sized and numbered; instrumentation identified including tag numbers. Piping plan drawings should be provided that show the routing of all lines along with pipe identification numbers. Elevation and detail drawings should be started but are not expected to be complete at this time. When equipment is furnished by other than the construction contractor, the interface should be clearly identified. Any areas on hold awaiting information should be identified.

c. Final. The final submittal will include all drawings and specifications and will be complete in a form ready to put out for bid. After the Government's review and comment incorporation, the package is considered ready to bid. The design analysis will be submitted, and unless otherwise stated in the scope of work, only revised pages that can be inserted into the concept design analysis are required.

11-5. DESIGN ANALYSIS. A complete design analysis will be prepared delineating the basis of design, references and criteria used, and a general description of the system. Flow rates, pressure drops, pipe wall thickness, and pipe sizes will be calculated. Test pressures will be taken into account when selecting pipe wall thickness and anchors. Corrosion allowance will be calculated on the basis of standard corrosion factors for the material used, the product handled, and 15 years material life (unless revised by the contract scope of work).

11-6. DESIGN CONSIDERATIONS

a. Alignment. The horizontal and vertical alignment of the piping will be carefully planned to use the inherent flexibility of the pipe to absorb expansion. Con-sideration will be given to road crossings and other obstructions in the route of the piping.

b. Expansion. The design of flexibility of the system, will consider the maximum and minimum temperatures to which the line will be exposed. This will include not only environmental temperature, but temperatures of cleaning processes such as steam or vapor cleaning. Ample provision will be made for such temperature ranges, and this will be covered by the design analysis. Where expansion of piping will be absorbed by using the inherent flexibility of the piping or by providing expansion loops and bends, the pipe expansion stresses will be calculated by a standard method used in industry such as the Tube Turn, Blaw-Knox, Grinnel, or M. W. Kellogg methods and provided in the design analysis. Where computer analysis is used, the analysis will include a user's manual and a sample problem.

c. Supports. Supports for aboveground piping will be designed with full allowances for the movement and forces developed by the piping either during operation, testing, cleaning, or shock loading, whichever is the most severe condition. Supports will be of ample strength to withstand the forces developed by the piping. Supports will be designed to allow free movement of the piping during expansion and to adequately guide the line without binding it. Support design will incorporate stock or production parts, provided they conform to the requirements of design loads and are commonly used. Accurate stress and weight balance calculations will be made to determine forces and movements at each support point, anchor, and equipment connection. Vibration and shock loads will be examined in detail and accommodated. All calculations will be included in the design analysis.

d. Anchors. Pipe anchors will be designed to withstand the maximum forces developed by the pipe system during the most severe condition of either regular operation, testing, shock loading, or cleaning. Anchors will be proportioned to not less than twice the section modulus of the pipe. Design calculations for anchors will be a part of the design analysis. These calculations should show forces, assumptions, soil bearing values, etc. When it is necessary to use a bellows type expansion device, anchors and supports will be designed to take the full pressure thrust at the highest pressure to which the line will be subjected, either in normal operation or during the pressure testing.

e. Drainage and Sectionalizing. System operation conditions will be taken into consideration when designing the drainage points and sectionalizing. If a system is to be cleaned in place, the line will be capable of being divided into short sections for ease of cleaning without cutting the piping. Drains will be located at low points, and if they are to be used for cleaning or flushing, they will be large enough to ensure adequate flow. Horizontal pipe runs will be pitched for gravity drain in the desired direction.

f. Seismic Design. Design of piping, equipment, supports, and anchors in geographic areas subject to earthquakes will conform to TM 5-809-10 and CEGS 13080. (Also see chapter 7, Structural.)

g. Noise Control. Design work will be in accordance with TM 5-805-4 and TM 5-805-9.

11-7. CLEANING. The details of the cleaning processes and the number and location of cleanings will be specified. The specification will call out the degree of inspection and will require the use of approved cleaning facilities. The contractor will be required to provide detailed cleaning procedures before piping is cleaned. Pipe or components cleaned in a shop off the job will be sealed against contamination through use of a substantial sealing method.

11-8. COMPONENTS. Components such as valves, strainers, gauges, and other devices will be specified in detail with pressure or temperature rating, size, capacity, pressure, and temperature ranges; test pressures, tolerances, and materials will be called out. (See appendix J, Equipment Major, Minor Measurements for equipment parameters.) Components will be cleaned to the specified cleanliness level at the manufacturer's plant; they will be sealed and packaged so as to arrive on the job site in the specified clean condition.

11-9. INSPECTION. Methods and degree of cleanliness and welding inspection will be specified. Generally, welding inspections will consist of visual and radiographic or other nondestructive inspection. The method of testing and the standards used will be documented.

11-10. TESTING. Detailed requirements will be specified for pressure testing, leak testing, and operational testing. Test requirements for components such as leak testing and proof testing will be called out in detail. Operational tests will also be indicated. Records of tests will be made and a reproducible copy turned over to the contracting officer. Performance and other tests of valves, strainers, etc., will require certification with copies furnished the contracting officer.

11-11. PIPING CONNECTIONS. The method of making piping connections will be specified. Welding and inspection of welding will be IAW the ASME Boiler and Pres-sure Vessel Code, ANSI Piping Code, and the American Welding Society Standards. A requirement for welding procedure, welding operator, and welder qualification and identification will be specified. No unqualified procedure or welder will be used. Detailed requirements for welding will be specified.

11-12. PROTECTIVE COATINGS. Protective coatings for both aboveground and underground piping will be specified with appropriate test procedures.

11-13. MATERIALS. The options on materials for the piping systems will be furnished as part of the design criteria.

11-14. PIPING IDENTIFICATION. Requirements for piping identification will be specified.

11-15. DRAWINGS

a. Piping System Drawings. Piping drawings will include plans and elevations of the piping runs with the location of expansion devices, anchors, and changes in direction indicated and located on both the plans and elevations. Sufficient detail will also be provided to ensure interface definition between piping systems and con-tractor- and Government-furnished equipment. Details will be furnished for supports, anchors, pipe sleeve closures, valve pits, guides, and other such features. A process and instrumentation diagram showing the system control components and instrumentation will be provided for each process piping system. Instrumentation symbols used will be IAW Instrumentation and Symbols Standard (ISA-S5.1).

b. Piping Details. Piping details will be shown in isometric wherever practical.

c. Computer-Developed Drawings. Computer-developed pipe detail drawings may be used when computer facilities are available.

d. Miscellaneous. Pipelines, valves, controllers, and instrumentation will be numbered on the drawings. A pipeline and valve listing will be provided.

11-16. SPECIAL CONDITIONS

a. Hazardous Facilities. Hazardous facilities require special design considerations which include selecting equipment items and materials that prevent damage and hazards to personnel and facilities. Hazards may be created by corrosive acids, explosions, fire, lethal gases, or other causes. AMC Regulation 385-100 will be used for designing facilities where hazardous (but non-nuclear) munitions materials will be manufactured, processed, stored, handled, or transported within a facility. The safety requirements of the American Petroleum Institute may be imposed for facilities asso-ciated with petroleum products or with the conversion of one energy form into another.

b. Hazardous and Toxic Waste. Hazardous and toxic wastes piped underground must have double containment and meet the requirements of Resource Conservation and Recovery Act (RCRA).